

# Sustainable and Energy Efficient Design Principles in Vernacular Architecture

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**Abstract**— The need for sustainable and energy efficient built environment keeps increasing day by day with the growing awareness in that field. This impact has started pushing vernacular architecture to the forefront in order to understand the principles used in vernacular architecture, that has led to sustainability and energy efficiency. Vernacular architecture has proven to be the best example for a sustainable environment. This paper aims to illustrate the identification of principles like spatial design analysis, climate responsiveness, indigenous technologies, locally available materials etc. that will provide important insights for the people involved in the development of sustainable built environments. The various principles of vernacular design and technologies that lead to sustainable performance and energy efficiency, both at settlement and dwelling levels are analysed.

**Keywords**— vernacular, sustainable, energy efficient, climate, indigenous technologies, materials, culture

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## I. INTRODUCTION

Vernacular architecture is the architecture of the locale. It is built by the local community and reflects the needs, function, their culture, geographical location, historical context etc. [Engin N et al, 2007]. Hence it is generally accepted that traditional or vernacular architecture is well adapted to the dominant climate of that region [Sandeep Sharma et al 2013]. Vernacular architecture has evolved through trial and error methods, because of the limitations of resources and known construction techniques. Vernacular architecture thus evolved with ways that were most efficient out of necessity. As a result, sophisticated and innovative building forms and designs evolved that are culturally adaptive and became environmentally sustainable. [Asquith et al 2006]. This is the reason behind the success of its continuity. Vernacular architecture can hence be seen as the essence of sustainability with its inherent characteristics. Vernacular settlements are thus also considered as the predecessors of sustainable built environments

## II. SUSTAINABLE DEVELOPMENT

“Sustainable development is the development that meets the needs of the present without compromising the needs of future generations”. In short it is nothing but reserving the natural resources for the future generation. It ties together the concern for the carrying capacity of the natural systems with the social, political and economic challenges faced by the humanity. Sustainable development can be carried out under three divisions, Economic, Environmental/ Ecology and Social.

## III. ENVIRONMENTAL / ECOLOGY

The ecological sustainability of human settlements is part of the relationship between humans and their natural, social and built environments.

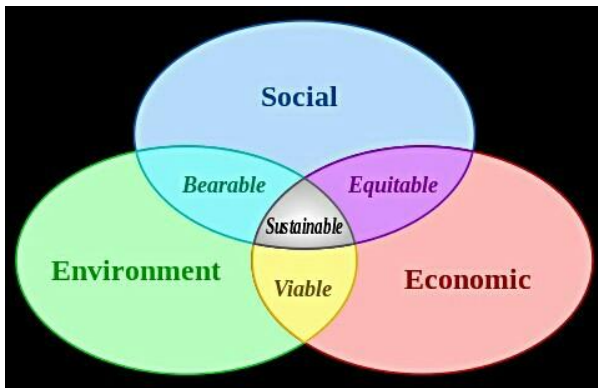


Figure 1. Scheme of sustainable development at the confluence of three constituent parts.

#### IV. BUILT ENVIRONMENTS

Built environment is a complex system that shapes enormous resource flows like materials used for construction, energy consumption and impacts the natural environment for decades if not centuries. If one considers typical design, construction and maintenance practices used today, the relationship between the built environment and natural environment is not sustainable. The need for sustainable and energy efficient built environment thus keeps increasing day by day with the growing awareness in that field. This impact has started pushing vernacular architecture to the forefront in order to understand the principles used in vernacular architecture, that has led to sustainability and energy efficiency.

#### V. VERNACULAR ARCHITECTURE

Vernacular architecture is the architecture of the locale. It is built by the local community and reflects the needs, function, their culture, geographical location, historical context etc. It is built using the locally available materials and using the known indigenous techniques. Hence it is generally accepted that traditional or vernacular architecture is well adapted to the dominant climate of that region. The use of locally available materials makes the architecture to have low environmental impacts. Hence it can also be used as an alternative for sustainable construction. Vernacular architecture has various design principles and technologies that lead to sustainable performance and energy efficiency.

#### VI. SUSTAINABLE DESIGN PRINCIPLES IN VERNACULAR ARCHITECTURE

- Planning and orientation of buildings
- Design and spatial flexibility
- Climate responsiveness
- Material usage and Indigenous construction techniques etc.
- Density and sense of place

For the purpose of exploring and understanding the sustainable design principles of a built environment, a coastal village 'Manapad', near Tuticorin is identified and critically studied. Located in the coastal stretch, Manapad is a fine example of sustainable communities that adapted to the hot and humid climate of the region and made use of only the local resources for their buildings. It is about 58 kms. south of Tuticorin, and totally depends upon the sea for its living. The topography of the area, also promotes this fact.

##### 6.1. Planning and orientation of buildings

The coastal stretch of Manapad, extends to about 3.15km, and has a total area of 260 acres. It is a Christian populated area with a total population of about 6000 inhabitants. It is close to Tiruchendur, one of the famous Hindu religious towns in South India and Kayalpatnam or Korkai, a Muslim town and an ancient silk route port.



Fig.2. Map showing the location of Manapad

The growth of the village originated from the shoreline as they depended fully on sea for their occupation. The growth further extended towards the western part of the village,

connecting the neighbouring places. The village is said to consist of three main clusters.

1. Fishermen /Paravas cluster
2. Nadar cluster
3. Upper class Paravas Cluster

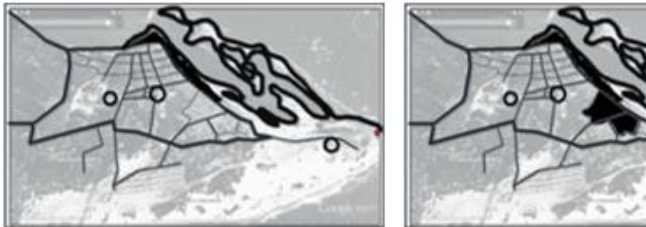


Fig. 3. Maps showing the growth of the village.

The climate of a region has direct influence on the settlement and in its built form. The houses in *Manapad* are all more than 100 years old. The architectural style of the houses are of *Ceylon-Portuguese* style. It has an extroverted planning with lots of open and semi-open spaces like *Balcoes*, verandas, and Balconies etc. which faces the street and sea. *Balcoes* are nothing but covered porches which are commonly found in the facades of traditional Portuguese houses. The *balcoes* were the places where men and women could sit together and chat with neighbours or just enjoy the evening breeze. The façade of most houses are symmetrical with tripartite divisions.

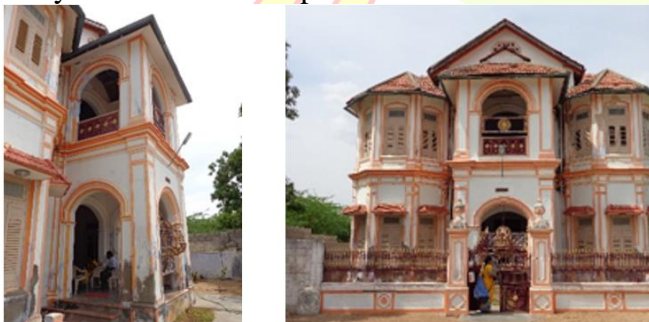


Fig.4. Balcony and *Balcoes* spaces for good air circulation and scenic views.

### 6.2. Design and spatial flexibility

The vernacular dwellings are adapted to specific social and cultural contexts. The built spaces are not arbitrary and are expressions of their way of life. The strength of vernacular architecture is that there is a natural harmony with the surrounding environment, climate, built form and people. Flexible and adaptable

design is another hallmark of the vernacular mode of building, which ultimately leads to sustainability. Housing that provides freedom of choice and is easily adaptive to changing needs and desires of the families over time are sustainable. *Manapad* has a very unique culture, because of the Portuguese invasion during the 14<sup>th</sup> century and trade links with *Ceylon* (present *Sri Lanka*). The village remained intact until 1540's and later on Indo-Portuguese style of Architecture came into existence. It thus has a cultural mix of *India*, *Portugal* and that of *Ceylon* and this uniqueness is revealed in their architecture. The culture of *Manapad*, has gone through many changes in its religion, occupation etc. They had a close bonding between the people of their community and the spaces related to their occupation. Thus the same architecture accommodated people from different cultures with minimal changes being done to it. This flexible and adaptable nature of vernacular architecture is one of the main reasons for its sustainability till the present day.



Fig.5. Open and semi-open spaces, but still being enclosed by wooden screens.

### 6.3. Climate responsive



Fig.6. View of arrangement of houses from the sea. The settlement is divided based on the topography of the land. The single storied

houses are placed near the coastal stretch where the land is slightly at a low level and the houses that are more than one floor are placed on the elevated land. Thus good air movement can be achieved throughout the settlement.

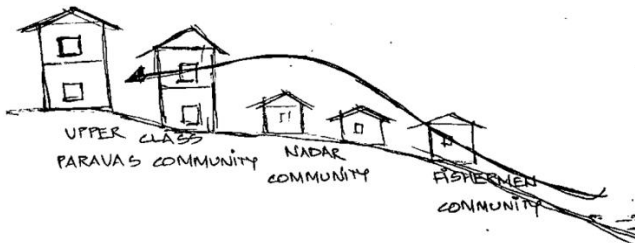


Fig.7. Logical arrangement of houses according to the site topography and building heights.

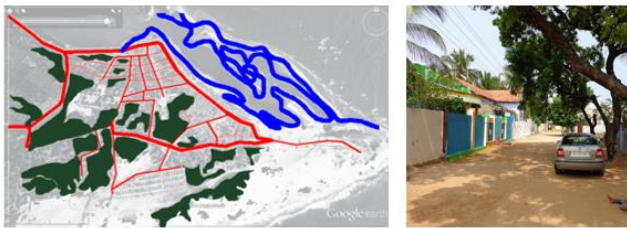


Fig.8. Vegetation at settlement level, street level and individual built form level.

The dwellings reflect occupant's activities in their lives while adapting to the warm and humid climate. The settlement is densely vegetated and hence it is protected from sun. The settlement is designed in clusters in the Fishermen community area and *Nadar* community area and in a proper grid iron pattern in the upper class *Paravar* community. The places which are designed in clusters, have lots of open spaces in between. These open spaces provide air flow movement, within the settlement in all directions. In areas where the houses are designed in a grid iron pattern, the houses have an extroverted planning with lots of open spaces around each dwelling unit, even though they are compounded individually. The houses also have lots of open and semi-open spaces like courtyards, balconies, *balcoes* etc., that facilitate good air movement within the building. The *balcoes* and balcony have wooden partition for privacy purpose, which have small perforations (Fig 10 c). These perforations filter sand and other dust particles and allow air movement within the place. Large

ornamental arched windows with louvered shutters, facilitate good air movement as well as visual connection between the house and the surrounding environment. The houses have high ceiling about 12' high and hence hot air can escape from the openings provided near the roof.

#### 6.4. Material usage

All the houses in the village have sloped roof with burnt clay tiles and have become a typical character of *Manapad*. This gives a good view when viewed from the sea. The houses are built using *Noraikal*, which is a type of coral stones (having high lime content). Lime plastered walls which are about 1'6" thick and hence increases time lag for thermal conductivity. Locally available timber are employed for construction and other ornamentation work as they were available in abundance. Rooms have false ceiling made of wood and this further helps in reducing the heat entering the building. The air gap in between the two ceilings facilitate this character. The colour of paints used in the building exterior are light in colour and hence reflect heat and radiation.

#### 6.5. Density and sense of space

Vernacular settlements are characterized by their compactness of form and efficient utilization of land and building ecology which has many environmental, economic and social advantages compared to the dispersed form of settlements of our modern cities. Energy consumed is decreased to a maximum extent because of this factor. Transportation within the village becomes easy, service lines are laid at a smaller distance and hence reduce laying cost and the maintenance also becomes easy. These settlements are extremely dense townscapes that are firmly unified buildings, showing a high degree of complexity, cohesiveness and social bonding. This results in a rich townscape endowed with much aesthetic appeal and distinguished cultural history. They are cloaked in their simplicity that drive the design and create a place which breeds spontaneity. Traditional vernacular architecture conceived

the building as a living architectural entity in its own right, shaped according to the distinct needs of social and cultural requirements [B. A. Kazimee, 2008]. *Manapad* houses are no different and share all the qualities and hence are sustainable.



Fig.9. Density of space creating a unified nature in Manapad.

## VII. CONCLUSION:

Human settlements are always sustainable in nature throughout the history. Only after this period, the art of living in harmony with nature and making use of locally available materials started diminishing. This led to the increase in the use of energy resources. Vernacular architecture brings out the full spirit of the place, by bringing in a genuine and symbiotic relationship between the environment, the built form and its inmates. We should thus represent the ecologically sensitive issues of a region, climate and culture to achieve a sustainable human settlement. If an intimate knowledge of a particular place is understood, then a sustainable built environment can easily be designed [Van der Ryn et al, 1996].

## REFERENCES

1. P.Jayasudha, M.Dhanasekaran, Monsingh D. Devadas & N.Ramachandran. A study in sustainable design principles: A case study of a vernacular dwelling in Thanjavur region of Tamil Nadu, India, Indian Journal Of Traditional

Knowledge, Vol 13 (4), October 2014, pp.762 – 770

2. Nisrine Naciri, Sustainable features of the vernacular architecture – A case study of Climatic Controls in the Hot-Arid regions of the Middle Eastern & North African Regions.
3. J.Fernandes, R.Mateus, L.Braganca, The potential of vernacular materials to the sustainable building design, C0 TAC Research Centre, University of Minho, Guimardes, Portugal.
4. Van der Ryn, Sim and Cowan, Stuart: Ecological Design, p 57, Island Press, Washington D.C. 1996.
5. Engin N, Vural N, Vural S, Sumerkan MR. Climatic effect in the formation of vernacular houses in the Eastern Black Sea region. Building and Environment 2007;42(2):960–9.
6. Sandeep Sharma and Puneet Sharma ,Traditional and Vernacular buildings are Ecological Sensitive, Climate Responsive Designs- Study of Himachal Pradesh International Journal of Chemical, Environmental & Biological Sciences (IJCEBS) Volume 1, Issue 4 (2013) ISSN 2320-4079; EISSN 2320–4087.